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Adsorption of EPS on PVDF micro-filters and its relationship with permeability decline

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INTRODUCTION

Membrane fouling is deposition of substances on the membrane surface or within its pores, and it lowers the permeability.

One of the fouling mechanisms is adsorption. Adsorption of materials on the membrane surface 1) lowers the permeability, 2) change the surface of the membrane, and 3) increase the need for membrane cleaning.

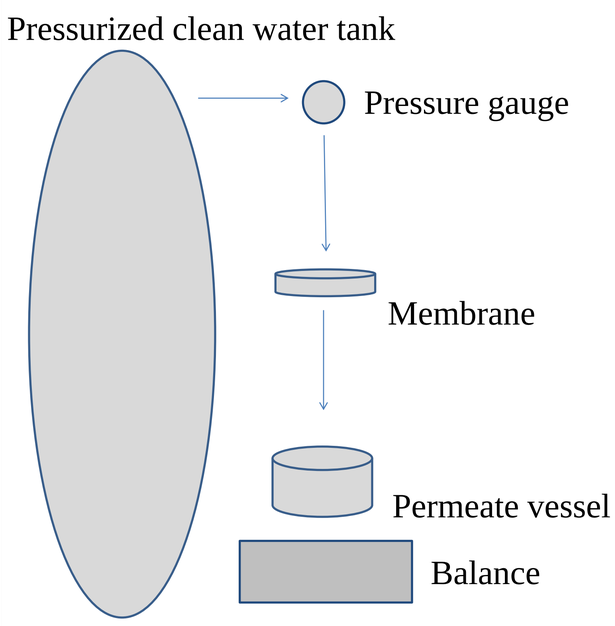
Organics often adsorp to membrane and different authors have reported that extracellular polymeric substances (EPS) is one of the main causes of fouling in MBR systems.

Different EPS fractions exist in wastewater 1) dissolved EPS also called Soluble microbial produced (SMP), 2) EPS loosely-bound to the flocs (LBEPS) and 3) EPS tigthly bound to the flocs (TBEPS).

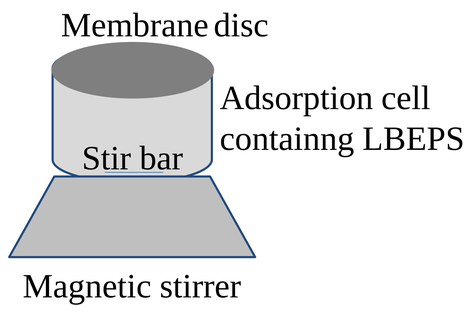
The idea of this work is to study how Loosely-bound extra-cellular polymeric substances (LBEPS) are present in the outer regions of sludge aggregates, and they are in contact with the membranes of the membrane bio-reactors (MBRs).

EXPERIMENTAL SET-UP

Permeability setup



Adsorption setup



Aims

1. Developing a robust method for extraction of LBEPS.
2. Developing a reproducible method for permeability measurements.
3. Developing method for testing adsorption of LBEPS on membranes.
4. Finding correlation between adsorption kinetics and permeability decline.

Materials and methods

LBEPS extracted from MBR sludge by centrifugation and ultrasonication.

The extracted LBEPS was characterised. It consist of 150 mg/L protein, 20 mg/L humic substances (modified Lowry method), and 70 mg/L carbohydrates (Anthrone method)

The prepared LBEBS solution was in contact with polyvynilidene fluoride (PVDF) microfilters (Alfalaval CO.) for several hours. See adsorption set-up.

Membrane permeability was measured before and after contact of membrane with the LBEPS solution by using the permeability set-up.

Results

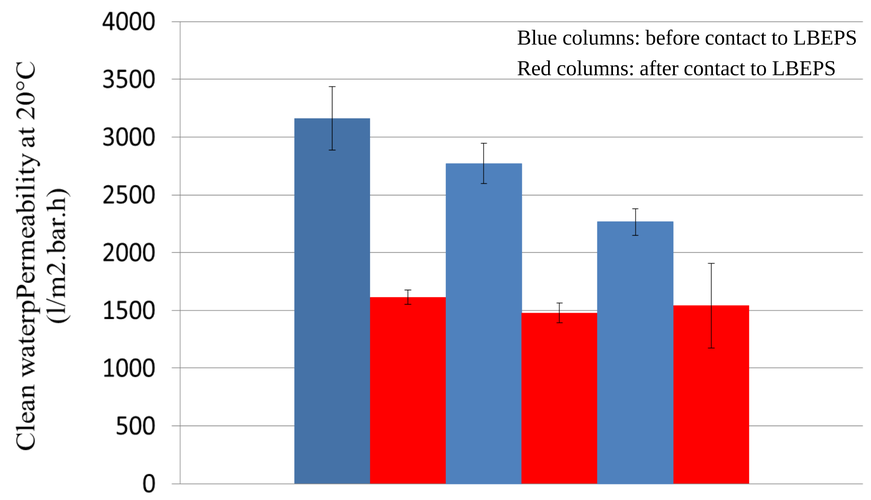


Figure 1: Effect of 9 h exposure at 20° C to LBEPS on membrane permeability.

Figure 1 shows that the three PVDF MF discs have different initial permeability, but after exposing to LBEPS, permeability of all of them declined and three membrane discs showed similar permeabilities.

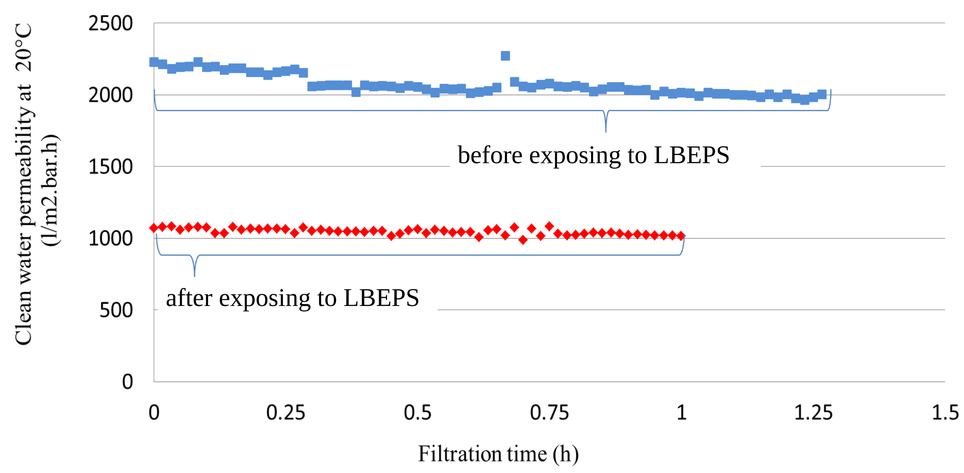


Figure 2: Effects of 67 h exposure to LBEPS on membrane permeability.

The experiment in figure 2 was done at 4° C so there was no biological growth and permeability decline is ascribed to inter-molecular affinity between the membrane active surface and the LBEPS components.

CONCLUSIONS

Exposing of LBEPS to the PVDF micro-filters reduced the membrane permeability to 50%.